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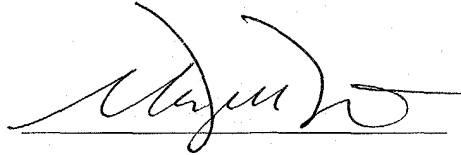
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Sir:

NOBUHIKO MATSUMOTO residing at 725 Espellete Place, Montebello,  
CALIFORNIA 90640, U.S.A., declares:

- (1) that he knows well both the Japanese and English languages;
- (2) that he translated the Japanese document entitled "Semiconductor Device and Method for Manufacturing the Same" from Japanese to English;
- (3) that the attached English translation is a true and correct translation of the above-identified Japanese document to the best of his knowledge and belief; and
- (4) that all statements made of his own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements are made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 USC 1001, and that such false statements may jeopardize the validity of the application or any patent issuing thereon.

Dated: June 1, 2001

A handwritten signature in black ink, appearing to read 'Nobuhiko Matsumoto', is written over a horizontal line.

Nobuhiko Matsumoto



# SPECIFICATION

## SEMICONDUCTOR DEVICE

### AND

## METHOD FOR MANUFACTURING THE SAME

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*FIELD*

### TECHNICAL FIELD:

[0001] The present invention relates to a semiconductor device and a method for manufacturing the same, and more particularly to a stacked package equipped with a plurality of semiconductor chips.

### BACKGROUND TECHNOLOGY:

[0002] In recent years, stacked packages in which semiconductor chips are stacked in layers have developed in order to promote miniaturization of semiconductor devices such as system LSIs. A stacked package has a structure shown in Fig. 3.

[0003] Referring to Fig. 3, a plurality of electrode pads are formed on an interposer substrate 31. A first semiconductor chip 32 is flip-chip mounted on the electrode pads. In other words, bumps 34 are provided at locations corresponding to the electrode pads on the surface of the first chip 32, and the bumps 34 and the electrode pads are electrically connected to one another such that the first chip 32 is flip-chip mounted on the interposer substrate 31.

[0004] A second semiconductor chip 33 that has a smaller measurement than that of the first chip 32 is mounted on the rear surface of the first chip 32 via an adhesive (not shown). The second chip 33 is wire-bonded to the interposer substrate 31 by wires 35. The first chip 32 and the second chip 33 are molded by a sealing resin 36.

[0005] On the opposite side of the chip-mounting side of the interposer substrate 31, solder balls 37 that are connection members to be used for mounting on a printed wire board are provided. The stacked

package and the printed wiring board are electrically connected by the solder balls 37. In the structure shown in Fig. 3, the size of the second chip 33 is smaller than the size of the first chip 32. However, depending on structures of system LSIs, the size of the second chip 33 may be greater than the size of the first chip 32.

**[0006]** In such a case, when the second chip and the interposer substrate are wire-bonded, heating of the second chip becomes difficult, and an ultrasonic load may concentrate at areas where corner sections of the first chip contact the second chip, and excessive stresses may be generated at those sections. As a result, the second chip may be damaged.

**[0007]** The present invention has been made in view of the problems described above, and it is an object of the present invention to provide a semiconductor device and a method for manufacturing the same, in which, in a stacked package having semiconductor chips stacked in layers, wire-bonding can be conducted without damaging the semiconductor chips even when an upper semiconductor chip has a greater size.

#### DESCRIPTION OF THE INVENTION:

**[0008]** In accordance with the present invention, a semiconductor device is characterized in comprising a first semiconductor chip mounted on a substrate,

a second semiconductor chip mounted on the first semiconductor chip, the second semiconductor chip being larger than the first semiconductor chip,

a base member that is disposed between the second semiconductor chip and the substrate, and

a connection member disposed below the substrate,

wherein the second semiconductor chip is supported by the base member.

[0009] According to the structure described above, the second semiconductor chip is supported by the base member. Therefore, when the second semiconductor chip and the substrates are wire-bonded, heat is sufficiently transferred to the second semiconductor chip through the base member, such that the heating of the second semiconductor chip is effectively conducted. Also, bonding pressure and ultrasonic energy that are applied to portions of the second semiconductor chip that extend outwardly from the first semiconductor chip can be alleviated. As a result, damage to the second semiconductor chip can be prevented.

[0010] In accordance with the present invention, a semiconductor device is characterized in comprising a first semiconductor chip mounted on a substrate,

a second semiconductor chip mounted on the first semiconductor chip, the second semiconductor chip being larger than the first semiconductor chip,

a filler layer that is provided between the second semiconductor chip and the substrate, and

a connection member disposed below the substrate,

wherein the second semiconductor chip is supported by the filler layer.

[0011] According to the structure described above, the second semiconductor chip is supported by the filler layer. Therefore, when the second semiconductor chip and the substrates are wire-bonded, heat is sufficiently transferred to the second semiconductor chip through the filler layer, such that the heating of the second semiconductor chip is effectively conducted. Also, bonding pressure and ultrasonic energy that are applied to portions of the second semiconductor chip that extend outwardly from the first semiconductor chip can be alleviated. As a result, damage to the second semiconductor chip can be prevented.

[0012] The present invention provides a method for manufacturing a semiconductor device, the method characterized in

comprising the steps of mounting a first semiconductor chip on a substrate,

mounting a base member outside the first semiconductor chip on the substrate, and

mounting a second semiconductor chip that is larger than the first semiconductor chip on the first semiconductor chip, in a manner that the second semiconductor chip is supported by the base member.

**[0013]** According to the method described above, the second semiconductor chip is supported by the base member. Therefore, when the second semiconductor chip and the substrates are wire-bonded, heat is sufficiently transferred to the second semiconductor chip through the base member, such that the heating of the second semiconductor chip is effectively conducted. Also, bonding pressure and ultrasonic energy that are applied to portions of the second semiconductor chip that extend outwardly from the first semiconductor chip can be alleviated. As a result, damage to the second semiconductor chip can be prevented.

**[0014]** The present invention provides a method for manufacturing a semiconductor device, the method characterized in comprising the steps of mounting a first semiconductor chip on a substrate,

mounting a second semiconductor chip that is larger than the first semiconductor chip on the first semiconductor chip, and

providing a filler layer in a manner to support the second semiconductor chip.

**[0015]** According to the method described above, the second semiconductor chip is supported by the filler layer. Therefore, when the second semiconductor chip and the substrates are wire-bonded, heat is sufficiently transferred to the second semiconductor chip through the filler layer, such that the heating of the second semiconductor chip is effectively conducted. Also, bonding pressure and ultrasonic energy that are applied to portions of the second semiconductor chip that extend outwardly from

the first semiconductor chip can be alleviated. As a result, damage to the second semiconductor chip can be prevented.

#### BREIF DESCRIPTION OF THE DRAWINGS:

[0016] Fig. 1 shows a cross-sectional view of a structure of a semiconductor device in accordance with a first embodiment of the present invention.

[0017] Fig. 2 shows a cross-sectional view of a structure of a semiconductor device in accordance with a second embodiment of the present invention.

[0018] Fig. 3 shows a cross-sectional view of a structure of a conventional semiconductor device.

#### BEST EMBODIMENTS OF THE PRESENT INVENTION:

[0019] Embodiments of the present invention are described below in detail with reference to the accompanying drawings.

[0020] Fig. 1 shows a cross-sectional view of a structure of a semiconductor device in accordance with a first embodiment of the present invention.

[0021] Referring to Fig. 1, a plurality of electrode pads is formed on an interposer substrate 11. A first semiconductor chip 12 is flip-chip mounted on the electrode pads. In other words, bumps 14 are provided at locations corresponding to the electrode pads on the surface of the first chip 12, and the bumps 14 and the electrode pads are electrically connected to one another such that the first chip 12 is flip-chip mounted on the interposer substrate 11.

[0022] A second semiconductor chip 13 that has a larger measurement than that of the first chip 12 is mounted on the rear surface of the first chip 12 via an adhesive (not shown). The second chip 13 is wire-bonded to the interposer substrate 11 by wires 15.

**[0023]** The base member 17 is disposed outside the first chip 12, and the base member 17 is mounted on the interposer substrate 11 through a thermosetting adhesive (not shown). In other words, the base member 17 is disposed at a location where it supports a proportion of the second chip 13 that extends beyond the first chip 12.

sub 917 **[0024]** The base member 17 may preferably be formed from a material that has a small difference in the thermal expansion coefficient with respect to the first and second chips 12 and 13. For example, the base material 17 may be formed from a metal such as 42 alloy.

**[0025]** The base member 17 may be in a frame shape that surrounds the first chip 12, or a column-like member that is disposed at a location where it can support the second chip 13. In order to securely support the second chip 15, an area of the base member 17 to be located may preferably be generally the same as that of the first chip 12 or greater.

**[0026]** The first chip 12, the second chip 13 and the base member 17 are molded by a sealing resin 16. On the opposite side of the chip-mounting side of the interposer substrate 11 are provided solder balls 18 that are connection members to be used for mounting on a printed wire board. The stacked package and the printed wiring board are electrically connected by the solder balls 18.

**[0027]** Next, a method for manufacturing the semiconductor device having the structure described above is described below.

**[0028]** First, the first chip 12 is mounted on the interposer substrate 11. In this case, the bumps 14 provided on the surface of the first chip 12 are abutted on the electrode pads of the interposer substrate 11 to thereby mount the first chip 12 on the interposer substrate 11.

sub 927 **[0029]** Next, the base member 17 is disposed outside the first chip 12. The base member 17 is affixed to the interposer substrate 11 by an adhesive such as thermosetting resin. Then, the second chip 13 that is larger than the first chip 12 is mounted on the first chip 12. In this case,

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cont.

the second chip 13 is affixed on the first chip 12 by an adhesive or the like. In this instance, portions of the second chip 15 extending outside the first chip 12 are supported by the base member 17.

**[0030]** Then, the second chip 13 and the interposer substrate 11 are wire-bonded. Thereafter, the interposer substrate 11 on which the first chip 12 and the second chip 13 are mounted is molded using a sealing resin 16. Then, solder balls 18 that are used for mounting on a printed wire board are provided on the opposite side of the chip-mounting side of the interposer substrate 11.

**[0031]** As the second chip 13 is supported by the base member 17 in the manner described above, when the second chip 13 and the interposer substrate 11 are wire bonded, heat is sufficiently transferred to the second chip 13 through the base member 17, such that the heating of the second chip 13 is effectively conducted. Also, bonding pressure and ultrasonic energy that are applied to portions of the second chip 13 that extend outwardly from the first chip 12 can be alleviated. As a result, damage to the second chip 13 can be prevented.

**[0032]** Fig. 2 shows a cross-sectional view of a structure of a semiconductor device in accordance with a second embodiment of the present invention.

**[0033]** Referring to Fig. 2, a plurality of electrode pads is formed on an interposer substrate 21. A first semiconductor chip 22 is flip-chip mounted on the electrode pads. In other words, bumps 24 are provided at locations corresponding to the electrode pads on the surface of the first chip 22, and the bumps 24 and the electrode pads are electrically connected to one another such that the first chip 22 is flip-chip mounted on the interposer substrate 21.

**[0034]** A second semiconductor chip 23 that has a larger measurement than that of the first chip 22 is mounted on the rear surface of the first chip 22. The second chip 23 is wire-bonded to the interposer substrate 21 by wires 25.



5 26 937 [0035] A filler layer 27 that is composed of a thermosetting resin or the like is provided as an undercoat layer between the first chip 22 and the second chip 13. In other words, the filler layer 27 is disposed at a location where it supports a portion of the second chip 23 that extends beyond the first chip 22.

[0036] In order to securely support the second chip 23, an area of the filler layer 27 to be located may preferably be generally the same as that of the first chip 22 or greater. It is noted that the filler layer 27 may preferably be composed of a material, for example, a non-conduction material such as a die-bonding material.

[0037] The first chip 22 and the second chip 23 are molded by a sealing resin 26. On the opposite side of the chip-mounting side of the interposer substrate 21, solder balls 28 that are connection members to be used for mounting on a printed wire board are provided. The stacked package and the printed wiring board are electrically connected by the solder balls 28.

[0038] Next, a method for manufacturing the semiconductor device having the structure described above is described below.

[0039] First, the first chip 22 is mounted on the interposer substrate 21. In this case, the bumps 24 provided on the surface of the first chip 22 are abutted on the electrode pads of the interposer substrate 21 to thereby mount the first chip 22 on the interposer substrate 21.

[0040] Then, the second chip 23 that is larger than the first chip 22 is mounted on the first chip 22. In this case, the second chip 23 is affixed on the first chip 22 by an adhesive or the like. Also, the filler layer 27 is provided between the second chip 23 and the interposer substrate 21, in other words, on an exterior side of the first chip 22 and between the first chip 22 and the second chip 23.

[0041] As the filler layer 27, a relatively low viscosity resin is initially used to fill the gap between the first chip 22 and the interposer substrate 21. By using a lower viscosity, the resin sufficiently penetrates

in spite of the presence of the bumps 24. Then a resin that is adjusted at a relatively higher viscosity is used to fill areas around the exterior sides of the first chip 22 and the lower surface of the second chip 23. In this instance, areas of the second chip 23 that extend outwardly from the first chip 22 are supported by the filler layer 27. Alternatively, the filler layer can be provided at once without adjusting its viscosity.

[0042] Then, the second chip 23 and the interposer substrate 21 are wire-bonded. Thereafter, the interposer substrate 21 on which the first chip 22 and the second chip 23 are mounted is molded using a sealing resin 26. Then, solder balls 28 that are used for mounting to a printed wire board are provided on the opposite side of the chip-mounting side of the interposer substrate 21.

[0043] As the second chip 23 is supported by the filler layer 27 in the manner described above, heat is sufficiently transferred to the second chip 23 through the filler layer 27 when the second chip 23 and the interposer substrate 21 are wire-bonded, such that the heating of the second chip 23 is effectively conducted. Also, bonding pressure and ultrasonic energy that are applied to portions of the second chip 23 that extend outwardly from the first chip 22 can be alleviated. As a result, damage to the second chip 23 can be prevented.

[0044] In the first and second embodiments, the first chips 12 and 22 and the second chips 13 and 23 that are semiconductor elements may include SRAMs or the like.

[0045] The present invention is not limited to the embodiments described above, and many modifications can be made. For example, the materials and sizes of the members are not limited to the embodiments described above, and may be modified in many ways.